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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/898,008	07/05/2001	Paul Anuzis	110023	1652

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EXAMINER	
LE, TOAN M	

ART UNIT	PAPER NUMBER
2863	

DATE MAILED: 04/13/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/898,008	ANUZIS ET AL.	
	Examiner	Art Unit	
	Toan M Le	2863	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *02 March 2004* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-18* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-18* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *05 July 2001* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-18 are rejected under 35 U.S.C. 102(b) as being anticipated by "Application of a Neural Network in Gas Turbine Control Sensor Fault Detection", Simani et al. (Referred hereafter Simani et al.).

Referring to claim 1, Simani et al. disclose a method for monitoring the health of a system (Abstract), which comprises performing at each of a plurality of times the steps of: constructing a condition signature from a plurality of condition indicators including (a) a plurality of vibration measurements acquired from the system or (b) one or more vibration measurements and one or more performance parameter measurements acquired from the system (page 183, section 2: 1st paragraph; equation (1)); predicting a normal signature from a model defining one or more inter-dependencies between the condition indicators, the normal signature corresponding to a condition signature for a healthy system (page 183, section 2: 1st and 2nd paragraphs); comparing the condition signature with the normal signature (page 183, section 3: 1st and 2nd paragraphs); and registering an event if the condition signature differs from the normal signature by more than a predetermined threshold (page 184, section 4: 1st and 2nd paragraphs; page 185, section 6: 1st paragraph).

As to claims 2, 5, 10, and 13, Simani et al. disclose a method for monitoring the health of a system, wherein the model is a learnt model comprising a neural network (page 183, section 2: 1st paragraph; page 184, section 4: 1st paragraph).

Referring to claim 3, Simani et al. disclose a method for monitoring the health of a system, wherein the model comprises a matrix with one or more non-zero off-diagonal terms to define the interdependencies (page 183, section 3: 1st paragraph; equations 4-5).

As to claims 4 and 12, Simani et al. disclose a method for monitoring the health of a system, wherein the steps of comparing the condition signature with the normal signature involves calculating a value for the normalized innovations squared (page 184, section 3: last paragraph).

Referring to claims 6 and 14, Simani et al. disclose a method for monitoring the health of a system, wherein the steps of comparing the condition signature with the normal signature involves calculating a prediction error (page 183, section 3: equation 6).

As to claim 7, Simani et al. disclose a method for monitoring the health of a system, wherein the times define successive intervals of at most 1 sec duration (page 184, section 5: 3rd paragraph).

Referring to claim 8, Simani et al. disclose a method for monitoring the health of a system, which comprises performing at each of a plurality of times defining successive intervals of at most 1 sec duration (Abstract; page 184, section 5: third paragraph) the steps of: constructing a condition signature from a plurality of condition indicators including (a) a plurality of vibration measurements acquired from the system or (b) one or more vibration measurements and one or more performance parameter measurements acquired from the system

(page 183, section 2: 1st paragraph; equation (1)); predicting a normal signature corresponding to a condition signature for a healthy system (page 183, section 2: 1st and 2nd paragraphs); comparing the condition signatures with the normal signature (page 183, section 3: 1st and 2nd paragraphs); and registering an event if the condition signature differs from the normal signature by more than a predetermined threshold (page 184, section 4: 1st and 2nd paragraphs; page 185, section 6: 1st paragraph).

As to claims 9 and 11, Simani et al. disclose a method for monitoring the health of a system, which comprises performing at each of a plurality of times defining successive intervals of at most 1 sec duration, wherein the normal signature is predicted from a model comprises a matrix with one or more non-zero off-diagonal terms defining one or more inter-dependencies between the condition indicators (page 183, section 3: 1st paragraph; equations 4-5).

Referring to claim 15, Simani et al. disclose a method for monitoring the health of a system, wherein the measurements are synchronously acquired from the system to a synchronization imprecision of at most 1 sec (page 184, section 5: 3rd paragraph).

As to claim 16, Simani et al. disclose a method for monitoring the health of a system, wherein the system comprises a gas turbine engine (Abstract).

Referring to claims 17-18, Simani et al. disclose a data processing system incorporated into a method for monitoring the health of a system, comprising: data acquisition means (figure 3) for acquiring a plurality of condition indicators from the system at each of a plurality of times defining successive intervals of at most 1 sec duration (page 184, section 5: 3rd paragraph), the condition indicators including (a) a plurality of vibration measurements or (b) one or more vibration measurements and one or more performance parameter measurements for constructing

a condition signature from the condition indicators (page 183, section 2: 1st paragraph) and for predicting a normal signature corresponding to a condition signature for a healthy system, the normal signature being predicted by a model which defines one or more inter-dependencies between the condition indicators (page 183, section 2: 1st and 2nd paragraphs); comparator means for comparing the condition signature with the normal signature (page 183, section 3: 1st and 2nd paragraphs); and registration means for registering an event if the comparator indicates that the condition signature differs from the normal signature by more than a predetermined threshold (page 184, section 4: 1st and 2nd paragraphs; page 185, section 6, 1st paragraph).

Remarks:

Response to Arguments

Applicant's arguments filed 3/2/04 have been fully considered but they are not persuasive.

Referring to claim 1, Applicant argues that "In particular, Simani fails to disclose constructing a condition signature from a plurality of condition indicators including a plurality of vibration measurements acquired from the system. In contrast, Simani discloses a plurality of unmerged residuals from the respective observers, wherein each observer is linked to an individual sensor or condition indicator.

In specification, page 21, lines 18-22, "When the training phase has ended and the model is receiving real-time data consisting of a sequence of condition signatures, the Kalman filter is again used to derive the most likely values for the elements of x(i) for each condition signature y(i)." Furthermore, in specification, page 20, lines 17-23, "The EM learning algorithm is applied to a Kalman filter model. In the linear case, this is a system with a measurement process of the

form y(i) = Cx(i) + v(i) where y(i) is a set of observations of hidden state x(i), C is a covariance matrix, and measurement noise v(i) is zero-mean and normally distributed with covariance matrix R."

Simani discloses on page 183, 1st col., section 2, equation (1), y(t) = Cx(t) where x(t) is the state vector, y(t) is the output vector of the system. C is constant matrix of appropriate dimension obtained by means of modeling techniques or identification procedures. Thus, Simani does teach constructing a condition signature.

Applicant further argues that "the residuals in Simani are never compared with other 'normal' residual. Further, Simani does not use thresholds to detect the faults. Accordingly, Simani fails to disclose or suggest the step of comparing the condition signature with the normal signature."

In the specification, page 21, lines 25-30, "For example, comparison of the normal signature with the condition signature can be on the basis of the normalized innovations squared (NIS). The innovations sequence v is the difference between the condition signature and the normal signature, so v(k) = y(k) – Cx(k/k-1), equation (3)."

Simani discloses on page 183, section 3, 1st and 2nd paragraphs, the difference between the condition signature and the normal signature is $e_i(t) = y_i(t) - y^i(t)$ where $y_i(t)$ is the condition signature modeling as described above and $y^i(t)$ is the normal signature (in absence of faults and measurement noises). Furthermore, Simani also disclose on section 4, 1st paragraph, "The neural network is applied in order to classify the residual $e_i(t)$ computed by observers according to the operation of the process" and using thresholds to detect the faults on section 6, page 185, 1st

paragraph, "The fault pattern comprises 4 fault conditions, namely no fault, and faults of 4%, 10% and 40%." Thus, Simani does teach comparing and registering steps.

In addition, Applicant argues that "Simani does not disclose or suggest the step of predicting a normal signature corresponding to a condition signature."

Simani teaches predicting a normal signature corresponding to a condition signature by constructing a condition signature $y_i(t)$ and predicting a normal signature from comparing the difference between $y_i(t)$ and $y^j(t)$, equation (6).

Applicant also argues that "Simani fails to disclose or suggest that vibration measurements should be used as output sensor signals, and thus fails to disclose or even mention any vibration measurements."

Simani teaches on section 5, page 184, 1st paragraph, vibration measurements of Gas turbine such as angular position, pressure at the compressor inlet and outlet and turbine outlet.

Applicant further argues that "However, it is respectfully submitted that the neural networks of Simani and the prior learnt model approach as taught in Applicants' claimed invention is completely different. However, the neural networks in Simani are merely used to classify the residuals which result from the operation."

Simani teaches on page 183, section 2, 1st paragraph, a linear dynamic process described by $y(t) = Cx(t)$ where $x(t)$ is the state vector, $y(t)$ is the output vector of the system. C is constant matrix of appropriate dimension obtained by means of modeling techniques or identification procedures. Thus, Simani does teach constructing a prior learnt model predicting a normal signature.

Applicant additionally argues that "Finally, Simani's device is limited to detecting only sensor faults, whereas Applicants' invention can also respond to unexpected events or occurrences (e.g., abnormal blade rubbing due to released lock plate, oil seal leak, or bind strike) in the system being monitored."

Simani discloses on page 184, section 5, 1st-3rd paragraphs, detecting pressures, temperatures, load conditions of gas turbine in operation with an accuracy.

Conclusion

THIS ACTION IS MADE FINAL.

Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Toan M Le whose telephone number is (571) 272-2276. The examiner can normally be reached on Monday through Friday from 9:00 A.M. to 5:30 P.M..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, John Barlow can be reached on (571) 272-2269. The fax phone numbers for the

organization where this application or proceeding is assigned are (703) 872-9306 for regular communications and (703) 872-9306 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 305-4900.

Toan Le

March 29, 2004

MARC S. HOFF
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800